LAV-Command & Control Upgrade Program – Test Overview

Test Integration Working Group – Meeting #2

6 July 05

Outline

- Generalizations
- Specific Applications to LAV C2 Upgrade
- Summary

Purpose of Government Tests

- Risk reducer in support of Program Decisions
- Identify problems prior to fleet introduction

"Test and evaluation shall be integrated throughout the defense acquisition process. Test and evaluation shall be structured to provide essential information to decision-makers, assess attainment of technical performance parameters, and determine whether systems are operationally effective, suitable, survivable, and safe for intended use. The conduct of test and evaluation, integrated with modeling and simulation, shall facilitate learning, assess technology maturity and interoperability, facilitate integration into fielded forces, and confirm performance against documented capability needs and adversary capabilities as described in the system threat assessment."

Source DoD 5000.1

Types of Government Tests/Phases

- Two main Testing evolutions:
  - Developmental Tests (DT)
    - PM LAV responsibility as Developing Agent
  - Operational Tests (OT)
    - MCOTEA responsibility as Independent Test Agent

- Various combinations/permutations and subsets used:
  - DT/OT or OT/DT
  - PQT or PVT
  - RDT or RDGT
  - Etc., etc.

Test Methods

Test will consist of making observations or measurements of a quantitative nature as a basis for verification of conformance to the specified requirement. Test may include some mathematical calculations using the test data, in order to provide evidence of conformance (meets or exceeds) to the specified requirement. Test normally requires instrumentation or measurement equipment. Instrumentation and measurement equipment will be appropriate for measuring the test used, and will be verified.

Demonstration will consist of actual operation, adjustment or reconfiguration of items, usually of a go/no-go nature, that provides evidence that the specified requirement is met. Items may be instrumented and quantitative limits of performance monitored and other characteristics such as human engineering features, maintainability, accessibility, transportability, Built in Test/ Built In Test equipment and /or Display data

Inspection is examination of a non-destructive nature, consisting of visual, audible or tactile checks; simple physical manipulation; and dimensional checks with respect to specification and or drawing compliance using mechanical or electrical measurement. Any or all of these may be necessary to verify conformance to a requirement. Inspect many also include visual examination of the CSCI code, documentation, etc.

Test Methods

Analysis makes use of recognized techniques to explain or illustrate the performance of a system or software product. The process of analysis will consist of application of empirical and theoretical relationships between conditions, facts, and test data; engineering analysis, established technical or mathematical models or simulations; algorithms, charts, graphs, circuit diagrams, or other scientific procedures to provide evidence that the specified requirement is met.

Survey is a method that is carried out by collecting statistically significant information regarding a selected item via questionnaire.

Certifications are signed documents from the contractor that substantiate performance with documented test reports, performance data, analytical data or vendor report.

NOTE: Generally…Test, Demonstration, Inspection, Analysis, and/or Surveys are used during DT and OT with Certifications used in Production phase for selected requirements.

What do we get from Test Methods?

- Proper data to be analyzed and documented in reports to support various programmatic decisions

  - Example: Production, fielding, etc.

Generalization Summary

"The PM, in concert with the user and test and evaluation communities, shall coordinate developmental test and evaluation (DT&E), operational test and evaluation (OT&E), LFT&E, family-of-systems interoperability testing, information assurance testing, and modeling and simulation (M&S) activities, into an efficient continuum, closely integrated with requirements definition and systems design and development. The T&E strategy shall provide information about risk and risk mitigation, provide empirical data to validate models and simulations, evaluate technical performance and system maturity, and determine whether systems are operationally effective, suitable, and survivable against the threat detailed in the System Threat Assessment. The T&E strategy shall also address development and assessment of the weapons support equipment during the SDD phase, and into production, to ensure satisfactory test system measurement performance, calibration traceability and support, required diagnostics, and safety. Adequate time and resources shall be planned to support pre-test predictions and post-test reconciliation of models and test results, for all major test events. The PM, in concert with the user and test communities, shall provide safety releases to the developmental and operational testers prior to any test using personnel."

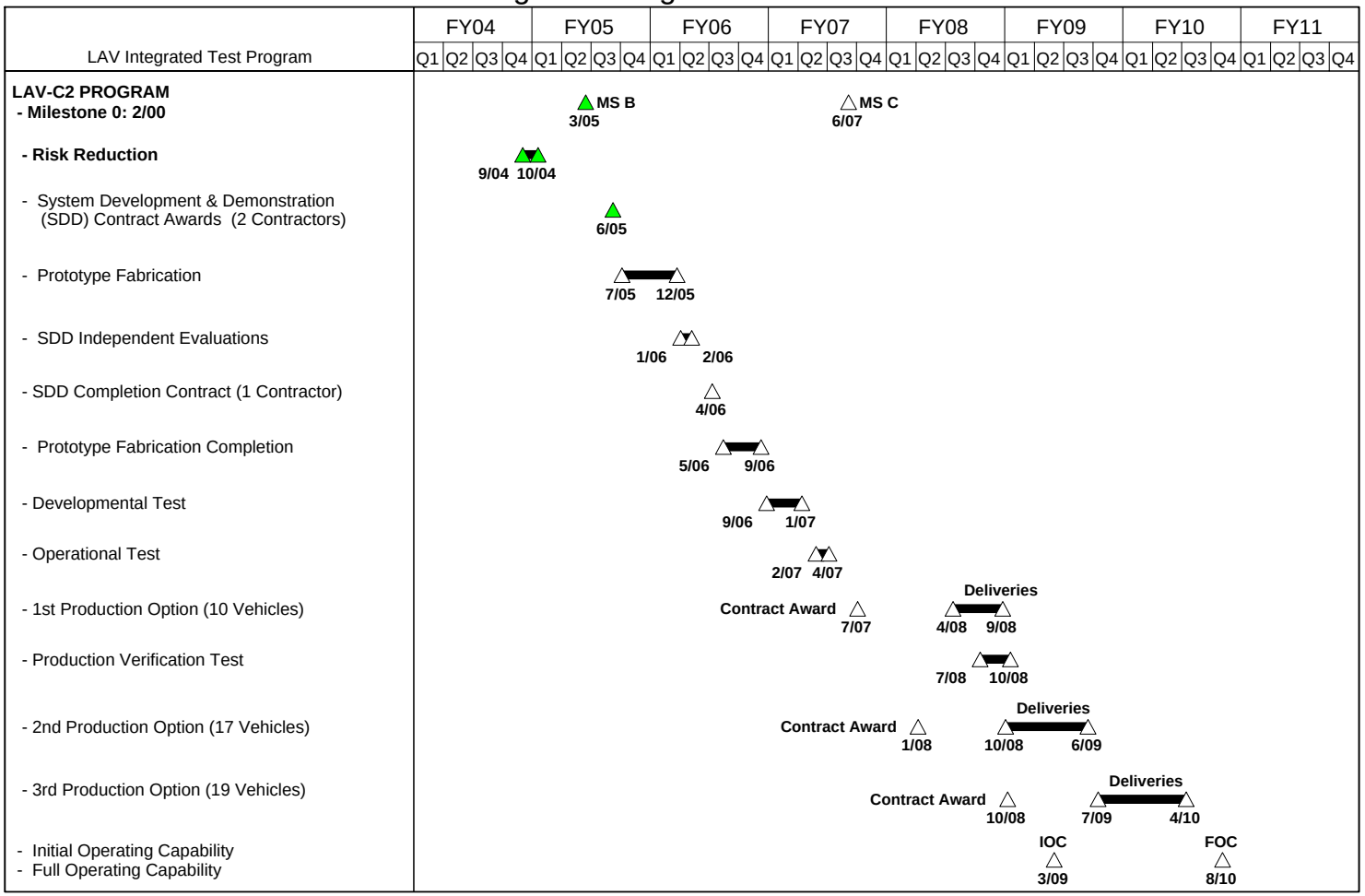
Source: DoD 5000.2 E5

LAV C2 Upgrade Test Program

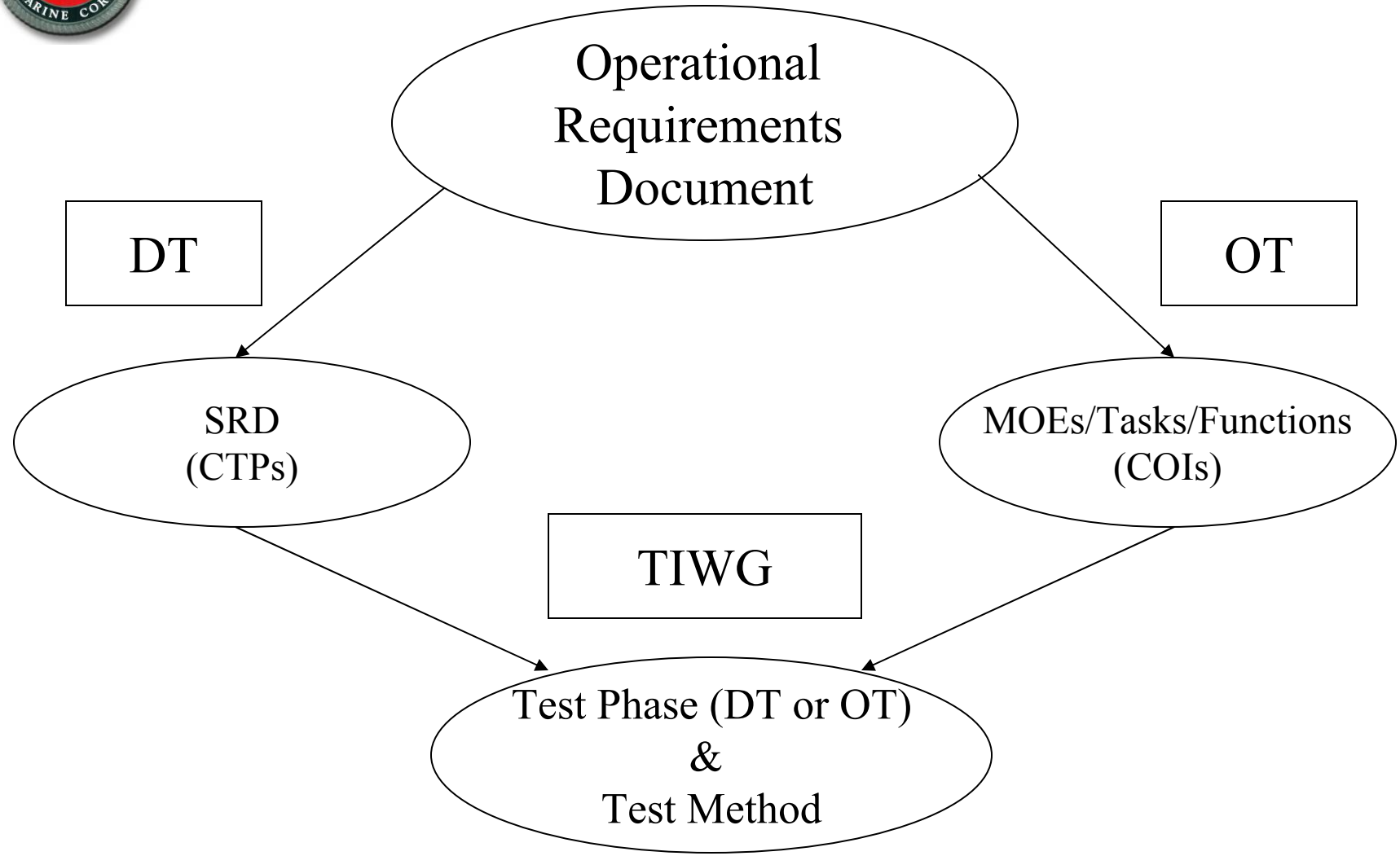
- Schedule
- Measures of Effectiveness and Suitability
- Critical Technical Parameters
- Critical Operational Issues
- Traceability Matrix
- TIWG Status and Actions

Test Schedule

Integrated Program Schedule



Deciding what/when to Test



Measures Of Effectiveness And Suitability

Operational Requirement	Parameter	ORD Threshold	ORD Objective	ORD Reference
ENVIRONMENTAL CONDITIONS	Ambient Temperature (°F)	-25 to +125	NA	4.a.(3) ORD Clarification ltr 1
	Operational when exposed to amphibious operations	With normal maintenance	NA	4.a.(4)(r)1
AUTOMOTIVE SYSTEM PERFORMANCE	Does not degrade LAV baseline	Multiple	Multiple	4.a.(4) ORD Clarification ltr 2, 3, 4, 9
COMMUNICATIONS SUITE	Tailorable Mission Configuration	NA	NA	Annex C 3.d ORD Clarification ltr 14
	Tactical Communication and Computer Capability	Internal Communications	NA	Annex C 3.d ORD Clarification ltr 13
		External RF Communications Equipment	NA	4.a.(4)(t) ORD Clarification ltr 15, 20, 21, 22, 23
		Computer Hardware & Software	NA	Annex C 3.d ORD Clarification ltr 5, 6, 11, 12, 16, 17, 18, 19
ELECTROMAGNETIC ENVIRONMENTAL EFFECTS	Resistant to Threats	NA	NA	MCOTEA Derived
	Interoperable & Compatible	NA	NA	MCOTEA Derived

Measures Of Effectiveness And Suitability

Operational Requirement	Parameter	ORD Threshold	ORD Objective	ORD Reference
NET-READY	Integrated Architectures	Documentation Provided	NA	MCOTEA Derived
	Network Centric Operations Warfare Reference Model	Documentation Provided	NA	MCOTEA Derived
	Key Interface Profile Compliance	Documentation Provided	NA	MCOTEA Derived
	DITSCAP Security Certification & Accreditation	Documentation Provided	NA	MCOTEA Derived
RELIABILITY, AVAILABILITY, & MAINTAINABILITY	Reliability	To be determined during DT and OT	NA	ORD Clarification ltr 7
	Availability	NA	NA	MCOTEA Derived
	Maintainability	NA	NA	MCOTEA Derived
MOBILITY, DEPLOYABILITY & TRANSPORTABILITY	Does not degrade LAV baseline	C-130 LCAC	NA	4.a.(4)
HUMAN FACTORS & SAFETY		NA	NA	MCOTEA Derived

Critical Technical Parameters

Supported Operational Requirement (Include ORD reference)	Technical Parameter	Develop-mental Stage Event	Threshold Value	Decision Supported
The LAV must be operational and maintainable in all types of climate and terrain where Marines deploy. 4.a.(3) ORD Clarification ltr 1 4.a.(4)(r)1	Do not degrade current vehicle performance (SRD 3.2.1.1) [Henceforth: "Do not degrade"]	DT	-25 to +125ºF, operating range	Milestone C
	Do not degrade (SRD 3.2.1.1)		With normal maintenance	
LAV - C² Automotive System Performance does not degrade LAV baseline 4.a.(4) ORD Clarification ltr 2, 3, 4, 9	Do not degrade (SRD 3.2.1.1) [Multiple]	DT	[Multiple]	Milestone C

Critical Technical Parameters

Supported Operational Requirement (Include ORD reference)	Technical Parameter	Develop-mental Stage Event	Threshold Value	Decision Supported
Tactical Communication and Computer Capability in support of MAGTF operations 4.a.(4)(t) Annex C 3.d ORD Clarification ltr 5, 6, 11, 12, 15, 16, 17, 18, 19, 20, 21, 22, 23	Intercommunications System (SRD 3.1.2)	DT	The Government furnished intercommunications system shall be integrated so that it can be employed for either one-to-one conversation or multiple staff member conferencing. The intercommunication system shall permit access to all radio nets.	Milestone C
	Radio Communications (SRD 3.1.1)		The Government furnished radio equipment shall be integrated into the vehicle to provide communications in all associated spectral bands for stationary operations and all bands except HF for on-the-move communications. The radio suite shall provide an encrypted capability to communicate via voice over UHF SATCOM, VHF, HF, and UHF and data over EPLRS and SATCOM.	
	Software Application Programs (SRD 3.1.3)		The vehicle shall provide the capability to use (i.e., employ the full functionality of) the Government-furnished Command and Control Personal Computer (C2PC) Gateway software in support of operations, intelligence, and situational awareness by 2 staff concurrently and Advanced Field Artillery Tactical Data System (AFATDS) software employed for fire support coordination by 1 staff.	

Critical Technical Parameters

Supported Operational Requirement (Include ORD reference)	Technical Parameter	Develop-mental Stage Event	Threshold Value	Decision Supported
Resistant to Electromagnetic Environmental Effects Threats and the system will operate compatibly and interoperate with other systems in the intended E3 Environment 4.a.(4)(t)	Electromagnetic Interference (EMI)/ Intra- and inter- system Electromagnetic Compatibility (EMC) (SRD 3.2.4.1, 3.2.4.2, 3.2.4.3)	DT	The vehicle shall provide intra-and inter-system EMC. Immune to EMI disruptive of normal C^4I performance. LAV-C^2 subsystems shall not be operationally degraded due to electromagnetic emissions from vehicle components or due to susceptibility of its constituent components. System components shall meet EMC requirements of MIL-STD-461, "Requirements for the Control of Electromagnetic Interference Emissions and Susceptibility", outlined in the Systems Requirements Document.	Milestone C
Reliability ORD Clarification ltr 7	Do not degrade (SRD 3.2.1.1)	DT/OT	LAV- C^2 subsystem reliability will be developed from data acquired during DT and OT	Milestone C
LAV-C^2 Upgrade System must be deployable and transportable to support USMC operations	Do not degrade (SRD 3.2.1.1)	DT	Swim Capable C-130 and LCAC transportable	Milestone C

Critical Operational Issues (COIs)

COIs are the OE and OS issues that must be examined in operational test and evaluation to evaluate/assess the system's capability to perform its mission.

Operational Effectiveness Issues

- Can the system operate in environments that are normally encountered during MAGTF operations?
- Does the LAV-C2 Upgrade impact baseline automotive system performance?
- Is the LAV-C2 communications configuration mission tailorable?
- Does the LAV-C2 possess the tactical communication and computer capability to support the fire support and maneuver requirements of a battalion or company commander during amphibious operations and subsequent operations ashore?
- Are the operational IA controls effectively implemented to protect, detect, respond, and restore the system in response to threats?
- Will the system operate compatibly and interoperate with other systems in the intended E3 Environment?
- Is the system compatible with SL-3 components, accessories, and ammunition?
- Is the system Net-Ready and interoperable with Service and Joint Systems in support of all operations?

Operational Suitability Issues

- Is the maintainability of the system suitable for operational employment?
- Is the availability of the system suitable for operational employment?
- Are the deployability and transportability characteristics of the system adequate to support USMC operations?
- Has the design of the system considered human factors in all facets of its use?
- Does the design of the system not present any safety and/or health hazards during use, handling, maintenance, transportation, storage or disposal in a tactical environment?

Trace Matrix

ORD Reference	MCOTEA			PM LAV		Test Phase (Planned/Completed)					Test Method					
Reference Para.	MOE	Task	Function	SRD Para.	SRD Description	Ktr Demo	DT (Gov't)	DT/OT	OT/DT	OT	Test	Demonstration	Inspection	Certification	Analysis	Survey (Opinion)
---				3.1	Key Performance Parameters (KPPs). Characteristics of such significance that failure to meet the related requirements will be cause for the rejection of the offeror's proposal are KPPs. The following six paragraphs (3.1.1-3.1.6) specify KPPs for the upgraded LAV-C^2.	Not tested; Description	Not tested;	Not tested;	Not tested;	Not tested; Description						
ORD 4.a.(4)(t) -1, -2, -4; *Annex C:* 3.c (lines [ln] 1-3), 3.d.1(ln 1-3), & 3.d.4 (ln 3-4)				3.1.1	Radio Communication. The Government furnished radio equipment identified in SRD Appendix 2 shall be integrated into the vehicle to provide stationary and on-the-move communications. The radio suite shall provide an encrypted capability to communicate via voice over UHF SATCOM, VHF, HF, and UHF and data over EPLRS and SATCOM. (Threshold) The radio suite shall provide the capability to exchange video signals, in addition to voice and data. (Objective)	X	X	X	X	X	X	X				
ORD 4.a.(4)(t) -1, -4 *Annex C:* 3.b(ln 1-2)				3.1.2	Intercommunications System. The Government furnished TOCNET intercommunications system shall be integrated so that it can be employed for either one-to-one conversation or multiple staff member conferencing. The intercommunication system shall permit access to all radio nets. (Threshold = Objective)			X			X	X				
ORD 4.a.(4)(t) -5 Annex C: 1, 3.a (ln 1-3), 3.d.2 (ln 3-4)				3.1.3	Software Applications. The vehicle shall provide the capability to use (i.e., employ the full functionality of) the Government-furnished Command and Control Personal Computer (C2PC) Gateway software in support of operations, intelligence, and situational awareness and Advanced Field Artillery Tactical Data System (AFATDS) software employed for fire support coordination as laid out in the following: Two Staff members use C2PC while 1 uses AFATDS software packages simultaneously (Threshold); all staff members can access and employ either C2PC or AFATDS software simultaneously.				X		X	X				
Annex C: 1; 2; & 3.d.2 (n 1-6)				3.1.4	Onboard Network. The vehicle shall have five networked workstations for the embarked staff. Each workstation shall be capable of accepting and employing both Government-furnished Miltope or Bullfrog laptop computers. A network configuration shall provide each staff workstation with the use of all software programs available on the vehicle via the on-board Expeditionary Fighting Vehicle (EFV) Multi-Processor Unit (MPU) server and associated Mass Memory Units (MMUs). An alternate network configuration shall provide each staff workstation with the use of software programs available on the vehicle, as presented in Table 1, but with the EFV MPU and MMUs removed from the architecture. (Threshold = Objective)	X	X	X	X	X	X	X	X			

Example: An "X" for planned.
Change it it "green filled" when complete.

Trace Matrix Line Test Info

ORD Reference	MCOTEA			PM LAV		Test Phase (Planned/Completed)						Test Method				
Reference Para.	MOE	Task	Function	SRD Para.	SRD Description	Ktr Demo	DT (Gov't)	DT/OT	OT/DT	OT	Test	Demonstration	Inspection	Certification	Analysis	Survey (Opinion)
Annex C: 1; 3.d.2(ln 6-8)				3.1.6	Operational Continuity Through Start-up. Provisions shall be made that ensure that C4I equipment operating at the time of vehicle engine start-up continue operating without adverse effect. (Threshold = Objective)	X	X			X		X			X	

Action: Define various configurations for C4I equipment to be operating

Proposed Test Method: Analysis of electrical load required to start with various configurations. Analysis showing how proposed means provides start capability

Demonstrate at hot environment, cold environment, and other conditions xx times.

Example

TIWG Status and Action Review

	ACTION	Responsible Organization/Individual	Assigned at	Estimated Completion	Comments
1	Establish the timeline for the submission of the Capability Product Document (CPD)	MCCDC- Major Zohlen	TWG #1	May 2005	
2	Draft TWG Charter for review/staffing	PM LAV- Mike Canavan/Derald Schnepp	TWG #1	March 31, 2005	Approval of TWG Charter planned for completion by TWG #2
3	Send formal request for MCTSSA support	PM LAV- Mike Canavan/Derald Schnepp	TWG #1	June 2005	
4	Update formal request for EPG support	PM LAV- Mike Canavan/Tom Sickles	TWG #1	June 2005	
5	Provide contact list for access to EFV web site to Major Wedge	PM LAV- Bill Ross/Derald Schnepp	TWG #1	March 31, 2005	
6	Draft "OT/DT Hot Weather" addendum to TEMP	MCOTEA- Dave Thomas PM LAV- Bill Ross	TWG #1	July 2005	Dave to draft for review; Bill to initiate staffing for signature
7	PM LAV Requirements Traceability Matrix/ MCOTEA Requirements Traceability Report Consolidation	PM LAV- Mike Canavan MCOTEA- Dave Thomas	TWG #1	July 2005	Provide a consolidated approach and matrix for tracing requirements through test results.
8	Develop IER Matrix	PM LAV - TBD	TWG #1		IER to be used as start point in establishing Test Plan for Interoperability Tests during DT/OT

Planned TIWG Schedule & Products

TWG No.	Purpose	Planned Dates[1]	Planned Action/Product	
1	Post-Milestone/Pre-Award Test Planning	16-17 March 2005	- Program & Test Strategy Review - TEMP Review - TWG Charter Discussions	- Test Sites Presentations - Outline of future TWG Actions
2	Post Award Planning	July 2005	- Review of Contractors' Verification Plans[2] - TWG Charter signed - RTR/RTM Crosswalk[3] draft	- DT/OT Evaluation Plan[4] draft - IER Matrix[5] - OT FDSC[6] discussions
3	Mid-Development Verification Review	October 2005	- Contractors Verification Status Review - RTR/RTM Crosswalk final	- Outline of Interoperability Tests - OT FDSC draft
4	Post-System Demonstration Review	February 2006	- Verification of Contractors' Independent Evaluation - TEMP Review - Outline of DT[7]	- DT/OT Evaluation Plan final - Interoperability Test DTP draft - OT FDSC final - DT Logistics Plan draft
5	Post Phase II Contract Option Award	May 2006	- DT DTP draft - Interoperability Tests DTP final	- DT Logistics Plan final
6	Pre-DT	Jul 2006	- DT DTP final - OT DTP draft	- OT Logistics Plan draft
7	Pre-OT	October 2006	- OT DTP final - OT Logistics Plan final	- Safe & Ready Certification
8	Pre-Milestone C	March 2007	- TEMP Review	- Test Results Review

TIWG Schedule & Products Notes

Notes:

1. Planned dates are based on Program events. As an example. TWG No. 2 will occur after Development Contract Awards. TWG dates will be adjusted as required to support the program schedule.
2. Contractors' Verification Plans will be reviewed for appropriate Test Methods, Verification Data and Analysis methods.
3. A matrix depicting the relationship of the DT events verifying the System Requirements Document (SRD), the Requirements Traceability Matrix (RTM), and the Requirements Traceability Report (RTR) of the Critical Operational Issues from the MCOTEA.
4. The DT/OT Evaluation Plan is a program level description of the analytical process planned to assess the technical risks, address performance and support requirements, and assess potential operational effectiveness and suitability.
5. A listing of critical Information Exchange Requirements (IERs) to support Certification evaluation and overall system interoperability performance.
6. The proposed Mission Essential Function (MEFs) for the OT Failure Definition and Scoring Criteria (FDSC) will be presented for discussion.
7. Proposed DT events traced to SRD; proposed DT test methods, data, and analysis methods will be reviewed.

Test Overview Summary

- Test is integral to LAV C2 Upgrade Program success

- TIWG process ongoing; key near term events are:
  - Trace Matrix completion
  - Site selections for Contractor Demonstrations
  - DT/OT evaluation plans
  - Information Exchange Req’ts (IER) Matrix
  - OT Failure Definition and Scoring Criteria development

LAV-C2 Upgrade Program